

The Mustard Growers Manual

**Prepared by
The Mustard Association**

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1/ TYPES OF MUSTARD AND THEIR USES

Mustard was one of the first crops domesticated by man. The seed's value as a spice soon resulted in its widespread dissemination along trade routes. The two species involved in condiment production in North America are: *Sinapis alba* (White or Yellow mustard) and *Brassica juncea* (Brown and Oriental mustards).

Mustard is used primarily in the production of dry (39%) and prepared mustards (61%). Dry mustard is extensively used as an ingredient in mayon-aise, salad dressings and sauces. Yellow mustard flour is also an excellent emulsifying agent and stabilizer and the ground product is widely used in sausage preparation. Oriental and Brown mustards are grown as oilseed crops in some parts of the world, but in Canada and the United States production is only as a spice.



Sinapis alba
White or Yellow Mustard

Brassica juncea
Brown and Oriental Mustard

2/ MUSTARD IN THE WORLD MARKET

Mustard has been a major special crop in North America since World War II disrupted supplies from western Europe. It was initially produced in California and Montana until the early fifties when some production moved north into Alberta. Canadian production increased over the last twenty years and has peaked during the early eighties.

During this last period the Canadian dollar was devalued against the U.S. dollar to a point of \$0.70 U.S. being equal to \$1.00 Canadian allowing the Canadian grower to produce the crop at a relatively lower cost. Mustard is grown where acceptable quality can be economically produced at the least unit cost.

Mustard is usually grown under contract so the grower and mustard manufacturer can have some feeling of security. It is a product for human consumption and the mustard manufacturers spend a lot of time and money on quality control. They ensure a close link to the grower by choosing to buy mustardseed from companies they know and trust. To ensure adequate supply, they contract with the mustard shipper to supply seed of a specific quality for a period of time ranging from six months to a year and a half. The mustard shipper contracts with growers in various areas where the crop is well adapted. The mustard shipper assumes some of the risk of supply as the grower is only obligated to deliver the actual crop he has harvested. If the crop is hailed out or otherwise destroyed, the shipper may have to replace it. Some growers produce mustard without a contract as a speculation that there could be a crop failure that will cause the market price to rise higher than the contract price. In a normal year, this non-contract seed is surplus to the market requirements and actually can have a depressing effect on prices in the following crop year. The major factor in the mustard market is that consumption is steady and growth is directly related to population growth. The market is limited to only those ethnic groups that have used it over the last centuries and there are only very limited alternative markets in times of surplus. It is a high protein oilseed but it is not popular in normal feed and vegetable oil markets because of the strong flavour.

3/ REGIONAL ADAPTATION

Mustard is a cool season crop well suited to a short growing season. Cultivars requiring 90-110 days to mature are available. Mustard will germinate at a soil temperature as low as 4.4°C (40°F) and the seedlings are quite frost tolerant.

Mustards are also quite drought tolerant, especially the Brown and Oriental types. Although mustard will not tolerate extended periods of drought the plant's tap root, which penetrates deeply 1.5m (5ft) into the soil under dry conditions, allows efficient use of stored soil moisture.

Mustard is well adapted to the Brown and Dark Brown soils of the Prairies and Great Plains. Dry sand and dry sandy loam soils should be avoided. The crop should not be sown where flooding of the soil may occur. Mustard plants prefer well aerated soils that do not become water logged; poor aeration in the root zone will permanently stunt their growth. Mustard performs best in soils with a near neutral pH (pH 7), but will tolerate alkaline (above pH 7) and slightly saline soils. Mustard's tolerance to saline soils is similar to that of barley.

Table 1 shows the average relative yields and days to maturity of the mustard varieties grown in Canada.

Table 1. Performance of condiment mustard varieties in Western Canada

TYPE AND VARIETY	YIELD AS % OF CUTLASS	MATURITY IN DAYS
<u>Oriental</u>		
Cutlass.....	100.....	96
Domo.....	99.....	96
Lethbridge 22A.....	92.....	96
<u>Brown</u>		
Commercial.....	95.....	96
<u>Yellow</u>		
Gisilba.....	70.....	99
Kirby.....	73.....	98
Ochre.....	70.....	99
Tilney.....	73.....	101

NORMAL YIELD RANGE *

Oriental and Brown mustards: 700-1,500 lbs/acre 760-1,630 kg/hectare

Yellow mustard: 700-1,200 lbs/acre 760-1,300 kg/hectare

*The normal yield range applicable to a specific growing area is available from either the local agricultural representative/county agent or from one of the contracting companies.

4/ MUSTARD IN A ROTATION

Admixtures are a particularly severe problem in mustard. Cow cockle, cleavers, wild mustard, wild buckwheat and volunteer rapeseed/canola seed are almost impossible to remove from the harvested crop and are a severe quality downgrading factor. The land for sowing should be essentially free from these problem weeds before seeding a mustard crop.*

*see 8/Weeds

Mustard can serve as a 'clean up' crop for grassy weeds such as wild oats. Herbicides specific for grassy weeds may be used effectively without adverse effects on the mustard crop. Volunteer mustard can be easily controlled in cereals with the use of herbicides. Herbicides should be applied early, as volunteer mustard plants become more resistant in later growth stages. Mustard crop residues do not provide sufficient trash to protect the soil from erosion during a summerfallow year.

Mustard has several insect pests and diseases in common with flax, canola, sweet clover, soybeans, field peas, lentils and sunflowers so these crops should not be sown on the same field more than once in four years. Cereals are not susceptible to mustard pests and diseases.

5/ SEEDBED PREPARATION

Surface soil structure has a marked effect on seedling emergence. Soils with very fine texture may form a crust when drought follows rain, as a result, tender seedlings may have difficulty penetrating the soil surface. Conversely, very coarse textured soils are not suitable because of the difficulty in preparing a satisfactory seedbed.

Uniform, shallow seeding to moisture promotes rapid germination, emergence, and growth. A properly prepared seedbed facilitates the mechanical planting of seeds and provides a suitable environment for germination. The seedbed should be firm, so that only a slight heel depression is produced by a person standing on the soil. It should be level, uniform, free of plant growth, warm, moist throughout its depth and have good granular structure with only enough large lumps to prevent wind erosion.

SEEDING RATES

Brown and Oriental mustards are usually seeded at 4.5-7.8 kg/ha (4-7 lbs per acre), while the larger seeded yellow mustard is seeded at 7.8-13.4 kg/ha (7-12 lbs/ac). Seeding rates can vary over a wide range without affecting yield. Moderate to high initial plant populations that are reduced in an early growth

stage by frost, hail, disease, or insects can still produce seed yields similar to those of undamaged crops.

At very low plant populations individual plants may not fully utilize the light, moisture, and soil nutrients available, thus reducing potential yield. Lower plant populations also provide less competition to weeds. High seeding rates may hasten maturity by a few days and result in a more uniform crop, but very high seeding rates can increase lodging.

SEEDING DEPTH

Seeds should be planted no deeper than is necessary to reach soil moisture, 1.5 to 2 cm (1/2 to 1 in.) is best. A firm seedbed will help to keep moisture around the seed long enough for germination, emergence and the development of a root system which can then reach into the soil to tap stored moisture.

SEEDING DATE

Seeding should take place as soon as a suitable seedbed can be prepared. Mustard plants are quite tolerant to frost in the seedling stage but a fall frost can cause a serious loss in yield and quality. Early seeding may allow the crop to benefit from spring moisture and escape heat stress that can cause abortion of flowers or pods.

The timing of rains, summer heat and frosts can favor either early or late seeding. The mustard grower should weigh all the factors and choose a seeding date that will minimize risk and maximize production. Generally it is uneconomic to seed mustard after the first week in June.

6/ FERTILIZER

Proper fertilization will increase both the yield and the quality of a mustard crop. Fertilization alone however will not increase either quantity or quality if the other management practices are not up to par. Nor will fertilizer increase yields if the addition of nutrients is not required. Therefore a successful program must be based on a knowledge of the soil's nutrient status and the fertilizer application tailored

to that specific soil. In all cases it is advisable to have the soil tested for nutrient requirements. Mustard seedlings are sensitive to salt injury. Soluble nitrogen, phosphorus, potassium or other salts close to the seed may be harmful except at very low rates.

NITROGEN

Mustard is highly responsive to nitrogen and its requirements are similar to that of wheat. Up to 11 kg/ha (10 lbs/ac) in any form except urea may be placed with the seed, up to 68 kg/ha (60 lbs/ac) of actual N or 45 kg/ha (40 lbs/ac) of urea can be sidebanded, while higher rates should be deep banded. High rates of N may result in extended maturity of the mustard crop so consideration should be given to seeding date and moisture availability when deciding what rate to use.

PHOSPHOROUS

Mustard's phosphorous requirement is equal to or greater than that of the cereals. Due to mustard's extensive root system it is able to utilize phosphorous fertilizer more efficiently and absorb more total phosphorous. Under normal soil conditions up to 25 kg/ha of P_2O_5 (22 lb/ac) may be placed with the seed. Higher rates may cause reduced germination. As much as 29 kg/ha P_2O_5 (26 lb/ac) may be placed with the seed under moist conditions or when applied with a discer or hoe drill. Deep banding, side banding or broadcasting should be used for higher rates.

POTASSIUM

Mustard's potassium requirement is similar to that of canola and barley. Rates higher than 20 kg/ha (18 lb/ac) K_2O should not be placed with the seed. Potassium in excess of the recommended rates for seed placement or sidebanding can be broadcast or deepbanded in the fall or spring.

SULFUR

Mustard has a relatively large requirement for sulfur. In soils where sulfur is deficient elemental sulfur (90-98% S) and agricultural gypsum (19% S) should be broadcast or deep banded at least one year before intended use by the crop, to allow for soil microbes to convert it to the available sulfate form. Ammonium thiosulfate (12-0-0-26) may be sprayed or banded in solution with other liquid fertilizers. Placement of sulfur fertilizers which also contain nitrogen and phosphorous, such as (16-20-0-14), (34-0-0-11) and (21-0-0-24), should be based on the precautions already stated for the nitrogen and P_2O_5 components.

Prolonged deficiency results in a general chlorosis or yellowing of new leaves eventually progressing to all the leaves. Under certain conditions a pink coloring may appear on the underside of leaves and on the mid vein. If the sulfur deficiency is severe, plants may fail to set seed or have shrunk and shrivelled seeds.

NITROGEN / SULFUR INTERACTIONS

Within a plant's metabolic system both sulfur and nitrogen are incorporated into structural and enzymatic proteins. The amount of sulfur that will be incorporated into protein is limited by the amount of available nitrogen and vice versa. The use of nitrogen without sulfur on sulfur deficient soils results in little or no yield increase.

7/ FLOWERING AND POLLINATION

Flowering begins with the lowermost buds on the main raceme. Side racemes flower later, with the highest branch starting to flower first. Under favorable conditions flowering will last for two to three weeks, with full plant height being achieved at the peak of flowering. Low temperatures decrease the rate of plant development, delaying the onset of the flowering period.

Flowers open in the early morning and pollen is dispersed by both the wind and insects. *B. juncea*, (Oriental and Brown mustards), is self fertile. Except where there are large numbers of pollinating insects, approximately 70% of the seed is produced by self pollination. *S. alba* (Yellow mustard) on the other hand is highly self incompatible; its seed development is a result of cross pollination. The stigma is receptive to pollination for 3 days after the flower has opened. Fertilization occurs within 24 hours after pollination. Soon after fertilization has occurred, the petals wilt and drop from the plant. Both the onset and duration of flowering are variable and depend on the weather.

About half of the flowers produced on a plant develop productive pods which are retained until harvest. Most productive pods are produced from flowers which open during the first 15 days of flowering on the main stem and the upper three branches.

If adverse conditions (disease, insects, weather) damage buds, flowers or pods during early flowering, the mustard plant will compensate for these losses by development of normally non-productive buds and flowers. This will often include development of branches arising from the axils of lower leaves.

The earliest developed pods have a competitive advantage over the late pods. Any nutrient or moisture stress on the developing flower clusters greatly affects flower and pod development. A decrease in nutrient supply results in reduced flowers and pods and these pods will be smaller with fewer, lighter seeds. Conversely, with adequate moisture, an increase in nutrient supply results in production of more flowers and pods containing more and heavier seeds. Under commercial conditions, moisture stress, often brought about by hot dry conditions during flowering, frequently limits the potential yield.

8/ WEEDS

PREVENTION

Use weed free seed, preferably of certified stock.

CONTROL OF WEEDS IN THE MUSTARD CROP

Good cultural practices and a suitable crop rotation* will reduce weed problems in your mustard crop. Recommendations for chemical weed control must be combined with proper identification of the weed problem. The herbicide chosen depends on the type of weed and the crop's tolerance to that chemical. Several herbicides are available for grassy and broadleaf weed control in mustard. Trifluralin is recommended for a wide spectrum of weed control. Annual publications put out by the provincial/state governments are the best source of up to date information.

9/ DISEASES OF MUSTARD

STAGHEAD OR WHITE RUST

White Rust or Staghead are the common names for a disease caused by the fungus *Albugo candida*. Crop losses caused by this disease are directly proportional to the number of stems with stagheads.

Symptoms appear in the seedling stage when creamy white pustules may occur on the underside of the leaves. The infection then spreads to the stems and pods, where green or white blisters form. A staghead may be produced on affected racemes. Stagheads are green at first but turn brown as they mature, becoming hard and dry.



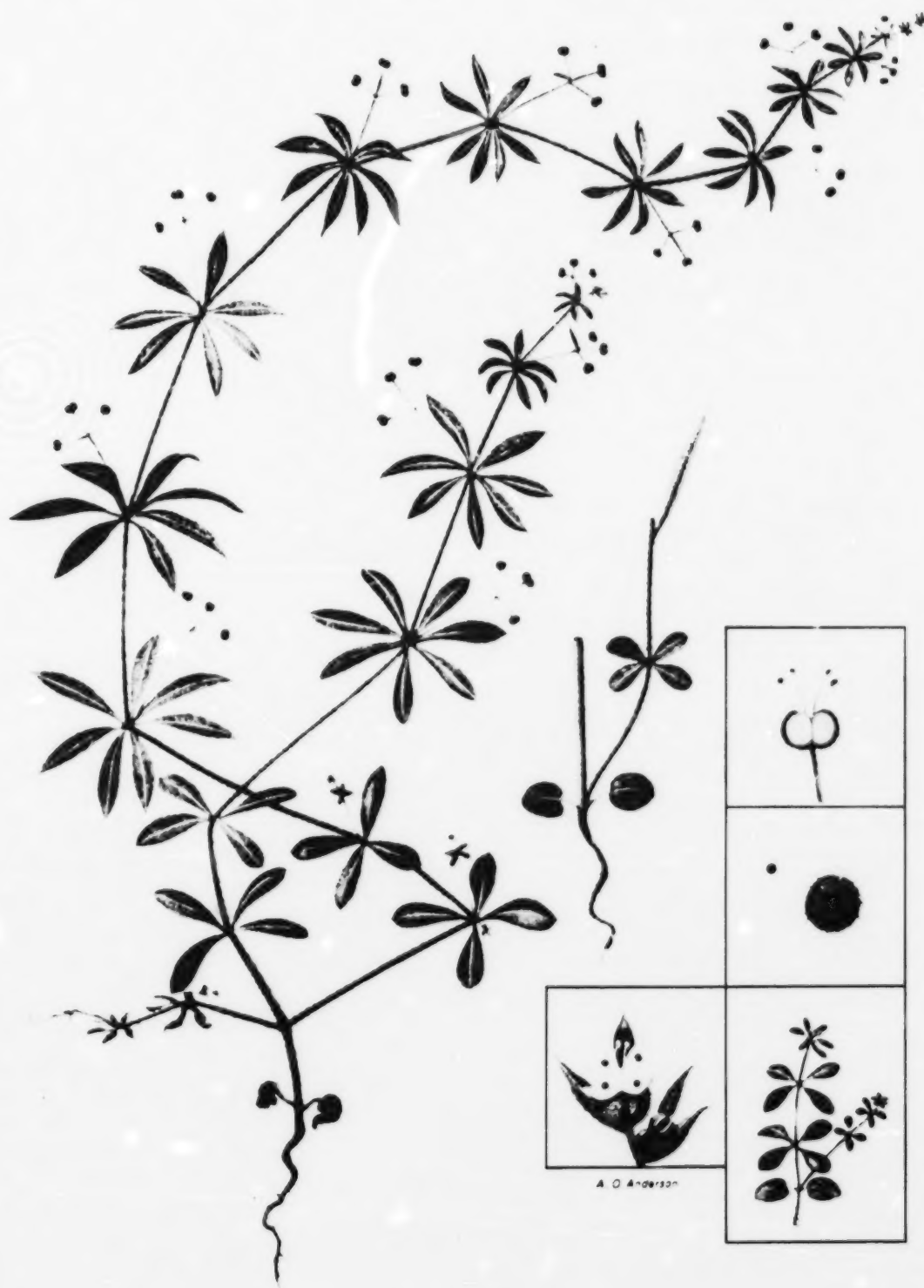
*See 4/Mustard in a Rotation

COW COCKLE
(*Saponaria vaccaria*)



A. O. Anderson

CLEAVERS
(*Gallium aparine*)



WILD MUSTARD FAMILY - CRUCIFERAE



Wild mustard - *Brassica kaber* var. *pinnatifida*. A. Plant; B. pod; C. seed.

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and the Minister of Supply and Services Canada

BUCKWHEAT FAMILY - POLYGONACEAE



Tartary buckwheat - *Fagopyrum tataricum*. A. Plant; B. seeds. Buckwheat - *Fagopyrum sagittatum*. C. seed.

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IDENTIFICATION OF CANOLA



CANOLA

B. Compestris fully clasps stem.



CANOLA

B. Napus partially clasps stem.



S. ALBA

B. JUNCEA

Leaf Terminates well up the petiole

Pictures courtesy of Agriculture Canada Research Station Saskatoon.

SCLEROTINIA Sp. STEM ROT

All mustards are susceptible to *Sclerotinia* but not to the same degree as Canola. There are fewer instances in mustard because the crop is usually grown in dryer warmer climates. Yield losses depend on the number of infected plants and the stage of the plant at the time of infection. Plants which are infected at early flowering will produce little, if any, seed, while those infected later suffer less yield loss. Additional losses may result from premature pod shattering.

The initial symptom of *Sclerotinia* stem rot is the appearance of soft, rotted areas or of light brown lesions on the stem, branches, pods and leaves. Plants with stems that are girdled by rot wilt rapidly. Infected plants are easy to spot in the field due to premature ripening. The fungus forms hard black resting bodies called sclerotia within the stem. The stems of infected plants shred easily and will release these sclerotia into the soil and trash during harvesting. A 3-4 year rotation with non cruciferous crops will help control *sclerotinia*.

OTHER DISEASES

Alternaria Black Spot, White Leaf Spot and Seedling Disease Complex can infect mustards but these diseases seldom occur at economically significant levels.

CONTROL

In general good cultural practices are the best disease control system. Keep good field records of disease occurrence, follow recommended rotational sequences, use seed treatments and be aware of potential host plants that could be removed or controlled in summer fallow, field margins and non-crop areas.

10/ INSECT PESTS

GENERAL GUIDELINES

Fields should be examined daily during the seedling stage and checked for signs of insect damage.

When damage is observed an attempt should be made to identify the insect responsible. If there is any doubt this identification should be confirmed with the local agricultural representative. If necessary examine the entire field and make counts to determine if the whole field needs treating. Insect numbers are frequently higher on the edge of fields and mustard is quite resilient to minor damage.

Assess your individual situation and seek professional advice if necessary. Never apply an insecticide that isn't registered for use on mustard and don't exceed the recommended rate. Always make sure equipment is clean and free from previous chemical residues prior to use.

New chemicals are continually being developed and registered, offering more effective control of insect pests and greater safety for the user and environment. Provincial and state governments publish new control recommendations each year. This information is available from your local agricultural representative.

Insect pests may attack the mustard crop over the entire growing season and can significantly reduce yields if present in large enough numbers. Figure 1 illustrates when the damaging stages of the major pests are found in the crop.

Figure 1. Time of attack by insect pests of mustard

PEST	TIME OF PLANT ATTACK					
	APR	MAY	JUNE	JULY	AUG	SEPT
Flea beetle		_____				
Cutworm		_____				
Red turnip beetle			_____			
Diamondback moth			_____			
Bertha armyworm				_____		

A/ PESTS OF SEEDLINGS

FLEA BEETLES (*Phyllotreta cruciferae* and *striolata*)

Two flea beetle species, the crucifer flea beetle and the striped flea beetle, attack mustard. Of the two, the crucifer flea beetle is the most abundant and serious pest. Both are 2-3 mm long (1/8 inch) and jump readily when disturbed.

The most serious damage from flea beetles results from spring feeding on mustard seedlings, which produces 'shot holes' in the cotyledons and young leaves. Flea beetle damage can result in yield losses and, if severe, in destruction of seedlings. If the crop has advanced beyond the seedling stage serious damage is unlikely to occur.

Seed treatment or in-furrow application of a recommended systemic insecticide should provide protection for the emerging mustard crop. No economic threshold level has been established for flea beetles on mustard but if 25% or more of total cotyledon area is destroyed, application of a foliar insecticide may be necessary.

RED TURNIP BEETLE (*Entomoscelis americana*)

These are dark red beetles with three black stripes running down their backs. They are about the same size as the Colorado potato beetle 1 cm (1/2 inch) in length. They overwinter in canola stubble fields in the form of reddish-brown oval eggs. The eggs hatch in early May and the larvae feed on volunteer plants.

The adult beetles migrate to nearby mustard fields. Plants attacked by red turnip beetles are often completely defoliated. The beetles are most abundant from mid June to early July. They move slowly on foot from the margins towards the center of the field and can be readily controlled by spraying.

Cultivation of canola and mustard stubble in the late fall and early spring may provide some control by burying the eggs and reducing larval survival.

CUTWORMS (*Euxoa ochrogaster* and *Agrotis orthogonia*)

The pale western cutworm is found in the open southern portions of the prairies and the redbacked cutworm is found in the park belt and more northern areas. The larvae of both species cut off mustard plants just below ground level. The larvae feed mainly at night and most cutworm damage occurs from late May to mid June.

Cutworm damage is often seen in the form of patches where the crop started but disappeared. These patches gradually enlarge, sometimes destroying a whole field. Check the edges of bare areas for cut off plants and sample the top 5 cm (2 inches) of soil in the area for larvae.

The economic threshold level is reached when there are three or more cutworms per square metre (10 sq. ft.). At this point pesticide application is recommended. It is best to apply the insecticide in the evening, when cutworms are feeding.

B/ PESTS OF BLOOMING AND PODDING STAGES

DIAMONDBACK MOTH (*Plutella xylostella*)

In early May and June the moths are carried into the Northern prairies on winds from the southern United States. The Diamondback is a small grey moth approximately 1.5 cm long (1/2 inch) with diamond shaped marking on its back. Female moths lay eggs on volunteer mustard, canola and related weeds and the first generation mature on these plants.

It is the second generation that causes yield losses in mustard because the eggs are laid on the growing crop and the pale green larvae feed on buds, flowers, and green pods. If disturbed the larvae wriggle spasmodically and drop from the plant suspended on a silken thread. The larvae pupate in white open lacework cocoons that can be attached anywhere on the plant.

The economic threshold for Diamondback moth is 300 larvae per square metre (10 sq.ft.). At this point foliar insecticide application should be considered.

BERTHA ARMYWORM (*Mamestra configurata*)

The adult moths are grey with white markings. They are night flyers and lay their eggs from mid June to mid July. The young caterpillars are green and feed on the lower leaves of the plant while older larvae, which are a darker color, feed on the upper leaves and pods.

Bertha army worm damage results primarily from feeding on green pods. Feeding on leaves does not appear to affect yield. The economic threshold for the bertha armyworm is 20-30 larvae per square meter (10 sq. ft.) if they are feeding on the pods.

C/ OTHER PESTS

Several other insect species may be encountered in mustard fields but these pests rarely become sufficiently numerous to warrant chemical control.

11/ HARVESTING AND STORAGE

GRADES OF DOMESTIC MUSTARD SEED (CANADA)

Grade Name	Class	Degree of Soundness	Standard of Cleanliness
No.1 Canada	Not less than 99.5% of one class.	Reasonably well matured sweet of good natural colour. May contain not over 1.5% damaged seeds including not over 0.1% heated.	May contain not more than 0.3% of other seeds that are conspicuous and that are not readily separable from mustard seed, including not over .1% of conspicuous seeds that are distinctly detrimental to quality, such as cow cockle.
No.2 Canada	Not less than 98% of one class.	Fairly well matured, sweet. May contain not over 3% damaged seeds, including not over 1.5% distinctly green seeds, and not over 0.2% heated.	May contain not more than 0.5% of other seeds that are conspicuous and that are not readily separable from mustard seed, including not over 0.2% of conspicuous seeds that are distinctly detrimental to quality, such as cow cockle.
No.3 Canada	Not less than 95% of one class.	May contain not over 5% damaged seeds, including not over 0.5% heated, and not over 3.5% of distinctly green seeds and heated in combination. May have the natural odour associated with low quality seed, but shall not have any odour that would indicate serious deterioration or contamination.	May contain not more than 0.7% of other seeds that are conspicuous and that are not readily separable from mustard seed, including not over 0.3% of conspicuous seeds that are distinctly detrimental to quality, such as cow cockle.
No.4 Canada	Not less than 90% of one class.	May contain not over 10% damaged seeds, including not over 1% heated, and not over 3.5% of distinctly green seeds. May have the natural odour associated with low quality seed, but shall not have any odour that would indicate serious deterioration or contamination.	May contain not more than 3% of other seeds that are conspicuous and that are not readily separable from mustard seed, including not over 0.7% cockle, and not over 1% wild mustard and cockle combined.

DOMESTIC MUSTARD SEED GRADING FACTORS - MAXIMUM TOLERANCES

DOMESTIC MUSTARD SEED GRADING FACTORS MAXIMUM TOLERANCE

DAMAGE				ADMIXTURES OF FOREIGN MATERIAL				
Grade	Heated	Distinctly Green seed	Total Damage	Earth Pellet	Stones	Sclerotinia*	Cockle**	Total*** Incl.
No.1	0.1%	1.5%	1.5%	0.01%	0.05%	0.1%	0.1%	0.3%
No.2	0.2%	1.5%	3.0%	0.2%	0.05%	0.2%	0.2%	0.5%
No.3	0.5%	3.5%	5.0%	0.3%	0.05%	0.3%	0.3%	0.7%
No.4	1.0%	3.5%	10.0%	1.0%	0.1%	1.0%	0.7%	3.0%

* Sclerotinia Sclerotiorum - when not removable as dockage is classed as foreign material distinctly detrimental to quality.

** Applies to all classes. In yellow mustard, tolerances in Nos. 1,2 and 3 Canada Yellow include cockle and wild mustard in combination.

*** All grades shall be essentially free of fertilizer pellets, including samples of commercially clean mustard seed. When containing one or more fertilizer pellets per 500 grams grade Sample Canada (class) Account Fertilizer Pellets.

SWATHING

Mustard is ready to swath when the seed moisture content is approximately 25%. At this stage the seeds will be firm when pressed between the fingers. The lower pods will have changed color but the upper pods may still be green. Oriental mustard can be swathed when roughly 75% of the seed have turned yellow. Brown mustard should not be swathed until at least 60% of the seeds are reddish brown in color.

There are differences in appearance between varieties, and the purple pigment often present in Brown mustard varieties makes them appear less mature than the usually lighter coloured Oriental mustards.

Totally immature, green seed will not change color in the swath. Even a small quantity of green seeds in a sample will result in downgrading by the processor. It is better to harvest a fully mature crop or even to harvest late, than to harvest too early. A small amount of shattering in a late harvest results in less economic loss than does the green seed contamination which may result from an early harvest. Late seeded and low lying areas where plants are less mature should be swathed and then threshed later to avoid contamination with green seeds, the seed being kept separate until carefully checked over to avoid spoiling the grade of the bin.

Yellow mustard may present problems in laying a swath because of its short stubble and bushy growth habit. To prevent wind damage in fluffy swaths it helps to use a light swath roller behind the swather. The height of the roller should be adjusted to press the swath into the stubble without shattering overripe pods. Excessive rolling will produce a swath that is too compact to dry quickly and difficult to pick up.

Brown and Oriental mustards grow taller than yellow mustard, allowing for a higher cutting height. Taller plants provide a more compact swath that is less subject to wind damage. Cutting just below the level of the lowest pod enables the swath to settle into the stubble and reduces the danger of blowing in high winds. The swath should be layed in the direction of the prevailing winds if possible.

DIRECT COMBINING

Mustard crops that are uniformly ripe and free from green seeds may be straight combined. Straight combining is also recommended if the crop is very short and there is a danger of the wind scattering the newly formed swaths. Yellow mustard should be straight combined whenever possible. Brown and Oriental types are more resistant to shattering than Canola and may also be straight combined successfully.

Shattering losses can be reduced by combining the ripe crop when the pods are still damp from dew or a light rain, provided that the moisture content of the seed is below 10.5%. If drying facilities are available combining can be done at 12 to 13% moisture. Artificial drying direct from the combine can avoid grade losses due to weather, reduce shattering losses and extend the harvestable period.

COMBINE ADJUSTMENT

To determine if there is a problem with cracked seed, run your hand into the threshed seed. If cracked mustard is present it will adhere to the hairs on the back of the hand and wrist. This indicates the need for further combine adjustment, probably lowering the cylinder speed. Combine cylinder and fan speeds should be lower than those used for wheat. A cylinder speed of 500-600 rpm's, a front concave clearance of 5-12 mm (3/16 - 7/16 in.) and a rear concave clearance of 3-5 mm (1/8 - 3/16 in.), with the chaffer set to a 10-15 mm (3/8 - 9/16 in.) opening and the lower sieve at 2-5 mm (1/8 - 3/16 in.) should give good results. Pick up speed should match ground speed to prevent the loss of pods.

USE OF DESSICANTS

Approved dessicants may be used in Canada to accelerate plant drying and to obtain uniform maturity but will not hasten maturity of the seed. By killing the green growth of pods, stems and weeds, the use of a dessicant should allow the crop to be straight combined. Dessicants are applied by aircraft when about 60% of the seeds have changed color in the pods. The crop can be combined when the seeds are fully mature and have undergone complete color change. If weather conditions are dry and warm dessication should be complete within approximately 7 days, but if weather conditions are damp and cool dessication may not be complete until 10-14 days after spraying.

DRYING SEED

Mustard seed is considered dry at a moisture content of 10.5% in Canada and 10% in the United States. However, for long term storage, a moisture content of less than 9% accompanied by a temperature below 20°C (68°F) is recommended.

The maximum drying temperature for a batch dryer is about 43°C (109°F). Slightly higher temperatures may be used but only by experienced operators who are totally familiar with their dryer. The seed temperature must never exceed 49°C (120°F). The temperature at which damage occurs is dependent on the seeds' moisture content.

If mustard has a moisture content above 15% moisture drying should be done in two stages to avoid cooking and dryer burning the seed. Mustard should be dried to approximately 13% moisture and thoroughly cooled. Expect the moisture content to rise, usually around 1%, when cooled as the seed reaches equilibrium with outside air. Then dry again down to approximately 9.5% moisture and cool.

Equipment designed for drying corn and wheat may require modification for use with mustard. A fine screen will be needed to prevent the seed leaking or being blown from the drying bin.

Because of the mustards' small seed size there is an increased resistance to air flow in the dryer. This has the effect of prolonging drying time and raising temperatures in the drying layer. Less air is moving through the heating unit consequently less fuel will be required to warm the air. Faulty operation or poor temperature control could allow the air to be heated to excessively high temperature which results in cooking the seed. It takes only a small amount of dryer burnt seed to downgrade a #1 grade to sample grade. Always check the dryer for potential areas where the seed will not clean out or circulate properly.

CONCLUSION

This publication is the first stage of developing a comprehensive guide to profitable mustard seed production. Any information you may have that in your own experience has improved your mustard production would be valuable to include in future updates of this publication.

Mail your comments and ideas to:

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